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BREDIN-ARCHBOLD-SMITHSONIAN BIOLOGICAL SURVEY OF DOMINICA[1]

7. Review of Bats of the Endemic Antillean Genus *Monophyllus*

By ALBERT SCHWARTZ and J. KNOX JONES, JR.[2]

As recently as 1959, Hall and Kelson (p. 116) commented on the status of the bats comprising the seven species of the phyllostomatid genus *Monophyllus*, endemic to the Antillean region: "Some of the species of *Monophyllus* are known from only one specimen and none is really well represented in collections. Therefore the extent and nature of individual variation is only poorly known. Further, the characters employed to distinguish each of the several species from others are minor differences in proportion that are best appreciated only by direct comparison." Consequently, Hall and Kelson's key to the named species of *Monophyllus* is based primarily on provenance of the known kinds rather than on morphological characteristics; such a course could hardly have been avoided since nowhere are there definitive statements concerning the variation of all the species involved. Miller, the first and only reviser (1900) of *Monophyllus*, had at that time eight specimens. From

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this suite of material he named three new species, one of which was from an unknown locality. Between 1900 and the present, additional material has accumulated, but, aside from occasional large series from specific localities, the accretion has been gradual; material from the Lesser Antilles has been especially slow in reaching collections.

The field work of the senior author has taken him to all islands whence *Monophyllus* has been reported although he has not in every case secured specimens. In his Antillean endeavors, Schwartz has had the assistance of Ronald F. Klinikowski, David C. Leber, and Richard Thomas; all have made collections of *Monophyllus* that have interest and value. The junior author spent six weeks on Dominica in 1966 under the auspices of the Bredin-Archbold-Smithsonian Biological Survey of Dominica and secured the first recent series of *Monophyllus* from any of the Lesser Antillean islands.

Eight names are currently associated with the genus *Monophyllus* Leach, as follows: *M. redmani* Leach, 1821 (type-species); *M. portoricensis* Miller, 1900; *M. plethodon* Miller, 1900; *M. clinedaphus* Miller, 1900; *M. cubanus* Miller, 1902; *M. luciae* Miller, 1902; *M. frater* Anthony, 1917; *M. ferreus* Miller, 1918. Of these, all but *M. c. cubanus* and *M. c. ferreus* are regarded as full species; *M. frater* is known only from fossil fragments and *M. clinedaphus* is known from a single specimen of unknown provenance. The ranges of the species, as presently understood, are: *M. redmani*, Jamaica; *M. portoricensis*, Puerto Rico; *M. plethodon*, Barbados; *M. cubanus cubanus*, Cuba; *M. c. ferreus*, Hispaniola; *M. luciae*, St. Lucia; *M. frater*, Puerto Rico, fossil; *M. clinedaphus*, unknown.

Both of us have collected specimens of *Monophyllus* on the Lesser Antillean island of Dominica. In borrowing specimens from various collections, we have inadvertently discovered unreported *Monophyllus* from several other Lesser Antillean islands. Although it was not our intent to examine all specimens of *Monophyllus* presently available, we have been able to to study a total of 139 specimens from throughout the West Indies. Abbreviations used in the present paper to denote collections in which *Monophyllus* are housed are: AMNH (American Museum of Natural History); AS (Albert Schwartz collection); BMNH (British Museum, Natural History, London); KU (Museum of Natural History, University of Kansas); MCZ (Museum of Comparative Zoology, Harvard University); RMNH (Rijksmuseum van Natuurlijke Historie, Leiden); USNM (United States National Museum). For the loan of material we are grateful to Karl F. Koopman, John E. Hill, Miss Barbara Lawrence, A. M. Husson, and Charles O. Handley, Jr. The senior author also wishes to acknowledge the gift of specimens of Cuban *Monophyllus* from Gilberto Silva Taboada.

Gary L. Ranck has supplied us with invaluable data on two of the holotypes in the United States National Museum.

All external measurements and weights, except for length of forearm, are those recorded by the collectors on original labels. Skull measurements and length of forearm were taken with vernier calipers; all are standard and expressed in millimeters. Length of maxillary toothrow is the alveolar length and greatest length of skull includes upper incisors. All weights are given in grams.

Systematic Treatment

Six nominal forms of *Monophyllus* (excluding for the moment *M. frater* and *M. clinedaphus* from consideration) vary in total length from a low mean of 61 (Hispaniola) to a high mean of 78 (Dominica), with the Jamaican population almost as large (mean 76) as the Dominican specimens, and the Cuban and Puerto Rican material almost as small (means 66 and 65) as the Hispaniolan bats. In general, other external measurements follow this same trend; means for length of forearm range from 36.9 on Puerto Rico to 42.1 on Dominica and St. Lucia. Cranial measurements likewise show the same tendencies; greatest length of skull varies from 19.0 (Puerto Rico) to 24.2 (Dominica), with means from 19.9 (Puerto Rico) to 23.4 (Dominica). Length of maxillary toothrow ranges from 6.8 (Puerto Rico) to 8.9 (Jamaica), with means from 7.1 (Puerto Rico) to 8.5 (Jamaica). Cranial measurements generally form a continuum (with Puerto Rican bats having the smallest skulls and Lesser Antillean or Jamaican bats having the largest) and are useful primarily at the subspecific level. Several cranial features, however, suggest that we are dealing with two species rather than one as would otherwise seem to be the case.

One of the characters that was presumed to separate the Barbadian *M. plethodon* from its relatives was the fact that the two upper premolars (PM 2 and PM 3 in formal terminology) were so crowded that the customary diastema between these two teeth was obliterated. Comparison of a skull of *M. plethodon* with those of *Monophyllus* from the Leeward and Windward Islands shows that this feature is common to all Lesser Antillean specimens in that the space between the upper premolars is narrow, much less than half the length of the first tooth. On the other hand, this space in Greater Antillean *Monophyllus* is long, being at least as long as half the length of the first premolar, and often longer. We have been unable to determine any other wholly consistent cranial or dental details and have placed emphasis on this relatively trivial feature as a basis for distinguishing two species (rather than six) among the living *Monophyllus*. We are deterred from considering all *Monophyllus* as conspecific by the

knowledge that at one time *M. portoricensis* and *M. frater* were contemporaneous on Puerto Rico. *Monophyllus portoricensis* has a long diastema (like other Greater Antillean forms) and *M. frater* has a short one (like the Lesser Antillean assemblage). Thus, Puerto Rico is interpreted as once having been inhabited by two stocks of *Monophyllus*, one Greater Antillean and the other Lesser Antillean, of which the latter is presumed presently to be extinct.

Once this dichotomy is recognized, the two species can be shown to differ in some average cranial measurements. Greatest length of skull in Greater Antillean bats varies from 19.0 to 23.9, for example, whereas that of Lesser Antillean bats ranges from 21.4 to 24.2. Postorbital constriction shows almost no overlap, with Greater Antillean *Monophyllus* having measurements of 3.8 to 4.6 and Lesser Antillean specimens having measurements of 4.5 to 5.0 Less trenchant differences include length of forearm (35.5 to 42.8 in Greater Antilles, 38.8 to 45.7 in Lesser Antilles). Although facial adornments have been gainfully employed to distinguish between congeneric species of other genera of phyllostomatids, the noseleaves and chin details in all *Monophyllus* appear identical. It is possible that we are overemphasizing the single dental character between the two species and that they are indeed preferably considered as conspecific, but such an action tends to obscure the one major difference between the two geographic segments of *Monophyllus*. It also poses the problem of the relationships of *M. frater*, which would then have to be regarded as a local derivative of *M. portoricensis* on Puerto Rico—a derivative oddly like its Lesser Antillean congeners—or else double invasion of the island by widely different stocks of the same species would need to be postulated. We feel that our arrangement is defensible zoogeographically as well as morphologically and provides a more meaningful systematic arrangement than that currently in use.

Monophyllus Leach

Monophyllus Leach, 1821, p. 75. [Generotype: *Monophyllus redmani* Leach.]

Monophyllus redmani Leach

DEFINITION.—A species of *Monophyllus* characterized by a combination of small to large size (total length 58–80), small hind foot (9–14), small ear (ear from notch 9–14), short forearm (35.5–42.8), small skull (greatest length 19.0–23.9), narrow postorbital constriction (3.8–4.6), and the upper premolars separated by a disatema one-half or more the length of the first premolar. The pelage is some shade of brown, tending generally toward paler shades.

Key to Living Species and Subspecies of Genus *Monophyllus*

1. Upper premolars separated by diastema equal to one-half or more of length of first premolar 2
   Upper premolars crowded, separated by small diastema less than half length of first premolar 4
2. Maxillary toothrow more than 7.5 mm 3
   Maxillary toothrow less than 7.4 mm . . . . . **M. r. portoricensis**
3. Greatest length of skull 22.8 mm or more . . . . . **M. r. redmani**
   Greatest length of skull 22.4 mm or less . . . . . **M. r. clinedaphus**
4. Forearm shorter (38.8–41.0 mm); maxillary toothrow shorter (7.2–7.8 mm). **M. p. plethodon**
   Forearm longer (40.1–45.7 mm); maxillary toothrow longer (7.8–8.5 mm). **M. p. luciae**

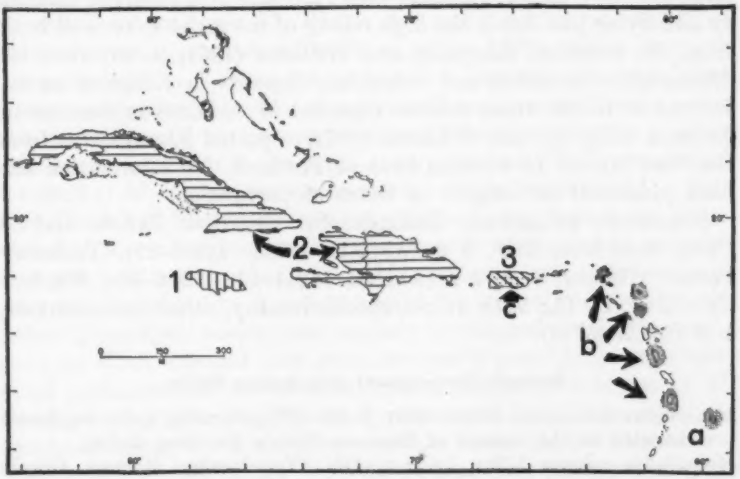

FIGURE 1.—Distribution of *Monophyllus* in the West Indies (*M. redmani*=lines; *M. plethodon*=stippling): 1, *M. r. redmani* (vertical lines); 2, *M. r. clinedaphus* (horizontal); 3, *M. r. portoricensis* (diagonal); a, *M. p. plethodon* (heavy stippling); b, *M. p. luciae* (medium); c, *M. p. frater* (open).

Monophyllus redmani redmani Leach

Monophyllus redmani Leach, 1821, p. 76. [Type-locality: Jamaica.]

DISTRIBUTION.—Known only from Jamaica (see fig. 1).

DEFINITION.—A subspecies of *M. redmani* characterized by large body size (total length 73–80, mean 76.1) but relatively short forearm (37.6–41.0, mean 40.2), large skull (greatest length 22.8–23.9, mean 23.3) with broad postorbital and mastoid regions and zygomata, and long toothrow. The color varies from dark brown to pale brown; there is no obvious dichromatism.

REMARKS.—*Monophyllus r. redmani* is the largest subspecies of the species and is readily separable from other subspecies by the

greatest length of skull (lower extreme in *M. r. redmani* 22.8, high extreme in all other subspecies 22.4). Other skull measurements (condylobasal length, postorbital constriction, mastoidal breadth) show some degree of overlap but length of maxillary toothrow (8.3–8.9 in *M. r. redmani*, 6.8–8.3 in other races) is almost as effective as greatest length of skull in distinguishing the nominate subspecies. Of external measurements, the total length of *M. r. redmani* is greater (73–80) than that of the other two subspecies (59–71), and measurements of ear from notch lie at the upper extreme for the species. Mensural data are given in tables 1 and 2.

The senior author took four specimens of *M. r. redmani* from a large cave at Windsor, Jamaica, where the bats were observed clinging to and flying just below the high ceiling of the moist cave, well back from the entrance. Koopman and Williams (1951, p. 20) recorded *Monophyllus* in surface and subsurface deposits in Jamaican caves, but not as fossils: these authors regarded *M. redmani* as common in Jamaica today (p. 23). Williams (1952) reported *Monophyllus* from the "bat layers" of a single cave at Portland. No information has been published on weights or dates of parturition.

SPECIMENS EXAMINED.—JAMAICA: St. Elizabeth Parish: Oxford Cave, Balaclava, 2 ♂, 3 ♀ (AMNH 45233, 45236–39). Trelawny Parish: Windsor, 3 ♂, 2 ♀ (AMNH 45241–42, 45244–46); Windsor Cave, 3 ♂, 1 ♀ (AS 5248–51); no specific locality, other than Jamaica, 1 ♂ (MCZ 45778).

Monophyllus redmani clinedaphus Miller

Monophyllus clinedaphus Miller, 1900, p. 36. [Type-locality: unknown, herein restricted to the vicinity of Baracoa, Oriente Province, Cuba.]

Monophyllus cubanus Miller, 1902, p. 410. [Type-locality: Baracoa, Oriente Province, Cuba.]

Monophyllus cubanus ferreus Miller, 1918, p. 40. [Type-locality: cave eight miles west-southwest of Jérémie, Département du Sud, Haiti.]

DISTRIBUTION.—Cuba and Hispaniola; on the latter island apparently as yet unknown in the Dominican Republic (see fig. 1).

DEFINITION.—A subspecies of *M. redmani* characterized by small body size (total length 59–70, mean 65.5 for six Cuban specimens and 60.7 for three Hispaniolan specimens), relatively long forearm (37.6–42.5, mean 40.1 for 32 Cuban specimens and 39.8 for 24 Hispaniolan specimens), skull of moderate size (greatest length 21.0–22.1, mean 21.9 for nine Cuban specimens and also for four Hispaniolan specimens) with broad postorbital region, moderately broad mastoid region, and narrow zygomata, and moderately long toothrows. The color is brownish, generally paler than in *M. r. redmani*.

REMARKS.—*Monophyllus clinedaphus* was described by Miller (1900, p. 36) on the basis of a single male in alcohol with skull re-

moved. The major difference between *M. clinedaphus* and the other "species" recognized in the same paper—*M. redmani, M. portoricensis, M. plethodon*—was that the "plane of the basioccipital and basisphenoid, instead of sloping forward at a faint angle as in the other species of the genus, pitches abruptly forward and downward at an angle of 32°." It may be recalled also that Miller had no material at that time from Cuba or Hispaniola and, thus, was unaware of the size and general characters of populations from those islands.

Gary L. Ranck (pers. comm., Feb. 8, 1966) has taken measurements for us of the skull and skin of the holotype (USNM 5210/37405) of *M. clinedaphus*. Pertinent measurements are: forearm 39.6; greatest length of skull 21.7, condylobasal length 19.6, postorbital constriction 4.1, maxillary toothrow 7.8. Ranck also confirmed the peculiarity of the basioccipital-presphenoid angle on which Miller placed so much emphasis, but Ranck suggested (as had C. O. Handley previously) that it may well be due to the fact that the skull was removed from a specimen in spirits and that preparation and subsequent drying possibly resulted in distortion of the skull. Later, the junior author examined the skull of *M. clinedaphus* and reached a similar conclusion, i.e., that it somehow had been distorted after collection. The base of the braincase, just above the basioccipital-presphenoid angle, clearly indicates that the skull has been bent, probably while wet and, therefore, possibly prior to the time it was extracted for study. Additionally, the palate is damaged, having been laterally compressed so that the toothrows are closer together than usual and nearly parallel. In any event, in all measurements except condylobasal length the holotype of *M. clinedaphus* agrees with *Monophyllus* examined from Cuba (the condylobasal length in the holotype is 19.6, whereas the lowest measurement in nine Cuban bats is 19.7). In the maxillary toothrow, the first two premolars are separated by a diastema slightly more than half the length of the first tooth, indicating that the holotype presumably originated in the Greater Antilles. We have seen no other specimen, however, with the peculiar basioccipital-presphenoid configuration of *M. clinedaphus* and conclude that this unique condition is indeed due to distortion. Therefore, we consider *M. clinedaphus* as the prior name for those bats that up to now have been known as *Monophyllus cubanus* Miller, 1902.

Mensural data for the two segments of *M. r. clinedaphus* are presented in tables 1 and 2. Of the three subspecies of *M. redmani*, the Cuban and Hispaniolan *M. r. clinedaphus* is intermediate in size between *M. r. redmani* of Jamaica and *M. r. portoricensis* of Puerto Rico. This is demonstrated most clearly by cranial measurements. Forearms of *M. r. redmani* and *M. r. clinedaphus* are comparable in size; thus, the forearms are relatively longer in *M. r. clinedaphus* than in

M. r. redmani since the former is otherwise a larger bat than the latter. *Monophyllus r. clinedaphus* can be separated completely from *M. r. redmani* on the basis of greatest length of skull; the two races are also virtually separable by length of maxillary toothrow. Other cranial measurements (condylobasal length, postorbial constriction, mastoidal breadth) show only slight overlap. Measurements of ear from notch also show little overlap, with *M. r. redmani* being the larger.

Monophyllus cubanus ferreus was based upon a series of 24 specimens from the type-locality in extreme southwestern Haiti. Of the type and paratypes, only two were skins, the balance being preserved in spirits. Skins and skulls of *Monophyllus* from Hispaniola are still uncommon in collections, but we have been able to examine one paratype, two freshly taken topotypes, and another individual from central Haiti. The characters of *M. c. ferreus* (in contrast to those of specimens from Cuba) were stated (Miller, 1918, p. 40) to be "color of upperparts clear hair-brown with a slight metallic gloss and with no obvious trace of the buffy-brown or fawn-color characteristic of the Cuban race. Measurements as well as cranial and dental characters apparently identical with those of true *M. cubanus.*" Our freshly taken Haitian specimens do not differ appreciably in dorsal color from older (1917–1928) material, but all Hispaniolan specimens are darker (more blackish) than older (1902) specimens from Cuba. A single Cuban *M. r. clinedaphus* collected in 1956 is comparable to older Cuban specimens. The differences in color between bats from

TABLE 1.—*Mensural data for eight populations of* Monophyllus *showing extremes and means (in millimeters) for five external measurements* (bracketed figures= number of specimens included in each calculation if different from N)

	N	Total length	Tail	Hindfoot	Ear from notch	Forearm
redmani (Jamaica)	9 ♀ 6 ♂	76.1 (73–80)[14]	9.7 (8–11)[14]	13.0 (11–14)[14]	13.8 (13–14)[4]	40.2 (37.6–41.0)
clinedaphus (Cuba)	17 ♀ 14 ♀ 17	65.5 (63–70)[6]	9.5 (8–11)[6]	10.5 (9–11)[6]	11.2 (9–13)[6]	40.1 (38.8–42.8)
clinedaphus (Hispaniola)	13 ♂ 12 ♀	60.7 (59–60)[3]	10.5 (10–11)[2]	13.0 (11–14)[3]	10.7 (10–11)[3]	39.8 (37.6–42.5)[24]
portoricensis (Puerto Rico)	10 ♂ 12 ♀	65.0 (60–71)	8.3 (7–10)	11.7 (10–13)	11.5 (10–12)[12]	38.9 (35.5–38.5)
luciae (Anguilla, Barbuda, Antigua)	4 ♂ 2 ♀	73[1]	12[1]	13[1]	–	41.6 (40.1–43.3)
luciae (Dominica)	10 ♂ 11 ♀	78.1 (69–84)[18]	13.6 (8–16)[18]	14.6 (12–15)[18]	15.7 (15–16)[16]	42.1 (40.6–45.7)
luciae (St. Lucia)	2 ♂ 11 ♀		–	–	–	42.1 (40.5–43.7)
plethodon (Barbados)	2 ♂	67	9	12	14	39.9 (38.8–41.0)

TABLE 2.—*Cranial data for eight populations of* Monophyllus *showing extremes and means (in millimeters) for six measurements* (size of samples as in table 1; bracketed figures = number of specimens used in each calculation if different from N in table 1)

	Greatest length	Condylobasal length	Zygomatic breadth	Postorbital constriction	Mastoidal breadth	Maxillary toothrow
redmani	23.3 (22.8–23.9)	22.0 (21.4–22.6)[14]	9.9 (9.1–10.4)[14]	4.3 (4.2–4.6)	9.7 (9.4–10.0)	8.5 (8.3–8.9)
clinedaphus (Cuba)	21.9 (21.0–22.4)[9]	20.6 (19.7–21.9)[9]	9.2 (8.7– 9.8)[9]	4.2 (3.9–4.4)[9]	9.0 (8.9– 9.3)[9]	8.0 (7.8–8.3)[9]
clinedaphus (Hispaniola)	21.9 (21.6–22.1)[4]	20.6 (20.2–20.7)[4]	9.3 (8.9– 9.7)[3]	4.3 (4.2–4.4)[4]	9.1 (8.6– 9.6)[4]	7.8 (7.5–8.0)[3]
portoricensis	19.9 (19.0–20.4)	18.5 (17.9–18.9)	8.5 (8.2– 8.8)[16]	4.0 (3.8–4.2)	8.4 (8.2– 8.8)	7.1 (6.8–7.3)
luciae (Anguilla, Barbuda, Antigua)	23.4 (22.8–24.0)[5]	22.1 (21.5–22.6)[5]	10.4 (9.8–11.0)[5]	4.8 (4.5–5.0)	9.6 (9.5–10.5)	8.2 (7.8–8.5)
luciae (Dominica)	23.4 (22.8–24.2)[18]	21.9 (21.0–22.5)[18]	10.1 (9.4–10.8)[18]	4.7 (4.5–4.9)[18]	9.8 (9.4–10.5)[18]	8.0 (7.8–8.4)[17]
luciae (St. Lucia)	23.1 (22.1–23.6)[8]	21.5 (20.6–22.0)[8]	9.9 (9.5–10.2)[8]	4.8 (4.6–4.9)[8]	9.8 (9.5–10.0)[8]	8.0 (7.8–8.2)[8]
plethodon (Barbados)	22.3 (21.4–23.2)	20.5 (19.5–21.4)	10.4[1]	4.8 (4.6–5.0)	10.1[1]	7.5 (7.2–7.8)

Cuba and Hispaniola are so slight and depend so much on original treatment and later storage of specimens that we cannot justify the retention of *M.c. ferreus* as a valid subspecies on this basis.

As Miller noted, the Cuban and Haitian populations do not differ in mensural characters. We have available external measurements for only three Haitian specimens and cranial measurements for only four. Although total length indicates a complete dichotomy between Cuban and Hispaniolan specimens (63–70 in Cuba, 59 and 60 in Hispaniola), these data are unreliable because of the small Haitian sample. Extremes of length of forearm for 24 Hispaniolan specimens (37.6–42.5) bracket those of 32 Cuban specimens (38.5–41.8). Cranial measurements of the two populations show identical or similar means, the greatest discrepancy being in length of maxillary toothrow (mean 7.8 in Hispaniola, 8.0 in Cuba). In the latter instance, there are data for only nine Cuban and three Hispaniolan specimens. It is possible that when additional Hispaniolan material becomes available, *M. c. ferreus* can be shown to be a recognizable subspecies, but at this time it appears neither identifiable nor nameworthy.

The recently collected Haitian specimens were taken in a large wet cave in a mesic situation in the Monts Cartaches massif; this cave may well be the same place whence W. L. Abbott secured the holotype and paratypes of *M. c. ferreus* in 1917. Miller (1904, p. 344) reported that William Palmer found this bat abundant on Cuba at the type-locality of *M. cubanus*, a damp cave; Palmer took not only *Monophyllus* but also *Natalus micropus*, *Mormoops blainvillei*, *Pteronotus parnellii*, *Pteronotus macleayi*, and *Phyllonycteris poeyi* at the entrance of this same cave. Allen (1911, p. 231) cited Gundlach's records of *Monophyllus* at Rangel in the Sierra del Rosario in Pinar del Río Province and at Guisa in eastern Cuba. Koopman and Ruibal (1955, p. 3) reported fossil *Monophyllus* from a cave in the Sierra de Cubitas in Camagüey Province, Cuba, and Anthony (1919, p. 637) took a single *Monophyllus* in a cave at Jarahueca, near Sabanilla, in Oriente Province. In Haiti, Miller (1929, p. 8) recorded taking a skull from owl pellet material at Diquini, Département de l'Ouest, and Koopman (1955, p. 110) reported a single fragmentary skull from a cave at Nan Café, Ile de la Gonâve. Presumably this latter specimen is referrable to *M. r. clinedaphus* although at least one chiropteran species (*Pteronotus parnellii*) has an endemic subspecies on Gonâve (*P. p. gonavensis*) that differs from its mainland Hispaniolan relative (*P. p. pusillus*). All the above records refer either to fossil or subfossil finds in caves or to cave-taken living bats. Like *M. r. redmani*, *M. r. clinedaphus* is a confirmed cave dweller. We have no data on weights or parturition for *M. r. clinedaphus*.

SPECIMENS EXAMINED.—CUBA: Habana Province: Cueva de Cotilla, 9 km southwest of San José de las Lajas, 3 ♂, 2 ♀ (AS 4776–80); Cueva de la Numancia, Aguacate, 1? (AMNH 176156). Oriente Province: Baracoa, 4 ♂, 2 ♀ (USNM 113668, 113671–73, 113675–76); Cueva de la Majana, Baracoa, 10 ♂, 10 ♀ (MCZ 11658, 16663–65, 16667–69, 16671–73, 16675, 16681, 16684, 16688–89, 16694–95, 16697–98, 16700). HAITI: Département du Sud: Grotte la Forêt, 9 km west-southwest of Jérémie, 6 ♂, 2 ♀ (AS 5599–606); 8 miles west-southwest of Jérémie, 7 ♂, 9 ♀ (USNM 219152–58, 219160–63, 219165, 219167–68, 219171, 219174). Département de l'Artibonite: St. Michel de l'Atalaye, 1 (USNM 253646).

***Monophyllus redmani portoricensis* Miller**

Monophyllus portoricensis Miller, 1900, p. 34. [Type-locality: cave near Bayamón, Puerto Rico.]

DISTRIBUTION.—Known only from Puerto Rico (see fig. 1).

DEFINITION.—A subspecies of *M. redmani* characterized by small size (total length 60–71, mean 65.0), short forearm (35.5–38.5, mean 36.9), small skull (greatest length 19.0–20.4, mean 19.9) with narrow postorbital and mastoid regions, and narrow zygomata, and short toothrows. The color is medium brown.

REMARKS.—The subspecies *M. r. portoricensis*, although of about the same body size as *M. r. clinedaphus*, has a distinctly shorter forearm and smaller skull. Greatest length of skull will separate *M. r. portoricensis* (19.0–20.4) from the other subspecies of *M. redmani* (21.0–23.9). Nonoverlap of cranial measurements occurs also in condylobasal length and length of maxillary toothrow; other skull measurements average smaller, but there is some overlap in these dimensions, the greatest being between *M. r. portoricensis* (high extreme 8.8) and Hispaniolan *M. r. clinedaphus* (low extreme 8.6) in mastoidal breadth. The forearm of *M. r. portoricensis* is distinctly shorter than those of the subspecies *M. r. redmani* and *M.r. clinedaphus*, both of which, despite a discrepancy of body size, have forearms of comparable lengths. Mensural data for 22 specimens of *M. r. portoricensis* are given in tables 1 and 2.

Freshly collected *M. r. portoricensis* seem intermediate in depth of dorsal pigmentation between the darker *M. r. redmani* and the paler *M. r. clinedaphus*. Such color differences are very difficult to assess, owing to the age of the skins involved. The color differences among all subspecies of *M. redmani* are slight at best; verification of supposed differences in pelage among the races must await the availability of fresh specimens from throughout the range of the species.

Anthony (1918, p. 349) commented that *M. r. portoricensis* was uncommon in Cueva de Fari near Bayamón but was the most abun-

dant bat at Cueva de Trujillo Alto. He reported a single fragmentary fossil skull of this subspecies from Cueva Catedral near Morovis, and we have examined a second skull from fossil or subfossil deposits in Cueva de Clara in the same area.

Schwartz and Thomas captured *M. r. portoricensis* in mist nets. Those from near Utuado were collected in a net set in a "cafetal" near the edge of the northern escarpment of the Cordillera Central at an elevation of 1100 feet (336 meters); this area is mesic and heavily forested. At a slightly higher elevation (1300 feet=397 meters) *Monophyllus* was collected near Cidra; here the net was set in a wooded ravine. In the southwestern portion of Puerto Rico, *M. r. portoricensis* was taken from mist nets set in a ravine and across an unused road, both in xeric woods and scrub near sea level. Since the Utuado and Guánica areas represent the two climatic extremes in Puerto Rico, *M. r. portoricensis* seems to tolerate a wide variety of habitats.

We have no data on weights or parturition in *M. r. portoricensis*.

SPECIMENS EXAMINED.—PUERTO RICO: 7.5 km east of Guánica, 1 ♂, 3 ♀ (AS 5526–29); 17.7 km northeast of Utuado, 1 ♂, 1 ♀ (AS 5538–39); Cueva de Trujillo Alto, Trujillo Alto, 3 ♂, 4 ♀ (AMNH 39433–35, 39444–47); Cueva de Fari, Pueblo Viejo, 3 ♂ (AMNH 39430–32); ca. 1 km northeast of Cidra, 1300 ft, 4 ♂, 4 ♀ (AS 5509–12, 5669–70); Cueva de Clara, near Morovis, 1 (KU uncataloged, fossil).

Monophyllus plethodon Miller

Monophyllus plethodon Miller, 1900, p. 35.

DEFINITION.—A species of *Monophyllus* characterized by a combination of large size (total length 67–84), large hind foot (12–15), long forearm (38.8–45.7), large skull (greatest length 21.4–24.2), broad postorbital region (4.5–5.0), and the first and second premolars separated by a diastema much less than half the length of the first premolar. The pelage usually is brown, but a few specimens are pale buffy tan.

Monophyllus plethodon plethodon Miller

Monophyllus plethodon Miller, 1900, p. 35. [Type-locality: St. Michael's Parish, Barbados.]

DISTRIBUTION.—Known only from Barbados (see fig. 1).

DEFINITION.—A subspecies of *M. plethodon* characterized by small body size (total length 67 and 68 in two known specimens), short forearm (38.8–41.0), small skull (greatest length 21.4–23.2), and short toothrows (maxillary toothrow 7.2–7.8).

REMARKS.—We are somewhat reluctant to regard the Lesser Antillean *Monophyllus* as comprising two subspecies. It is particularly unfortunate that Barbados is the type-locality of *M. plethodon* since, other than the holotype, we have examined only one specimen from

that island. Measurements of the male holotype of *M. plethodon*, taken for us by Gary L. Ranck, plus those given by Miller (1900, p. 38), show that it is somewhat smaller than the other individual, which was collected in 1961. It is purely on the basis of the holotype that we recognize *M. p. plethodon* as distinct from other Lesser Antillean populations; the second specimen (also a male) has measurements that fall within the parameters established by other Lesser Antillean *Monophyllus;* those of the holotype do not. It is possible that *Monophyllus* from Barbados average slightly smaller than their relatives elsewhere in the Lesser Antilles and, for this reason, we accept *M. p. plethodon* as a distinctive Barbadian subspecies with full cognizance that additional material from Barbados may well demonstrate the incorrectness of this conclusion.

On the basis of the single fresh male examined, there seem to be no differences in color between *M. p. plethodon* and the subspecies *M. p. luciae* that occurs on other Lesser Antillean islands. The recently collected specimen was taken in a mist net set between the buttresses of the road bridge at Jack-in-the-box Gully. The gully is a steep-sided and wooded ravine in an area otherwise devoted to cultivation of sugarcane. *Artibeus jamaicensis* was the only other bat taken in the gully.

SPECIMEN EXAMINED.—BARBADOS: St. Thomas Parish: Jack-in-the-box Gully, 1 ♂ (AS 5302).

Monophyllus plethodon luciae Miller

Monophyllus luciae Miller, 1902, p. 111. [Type-locality: St. Lucia.]

DEFINITION.—A subspecies of *M. plethodon* characterized by a combination of large size (total length 69–84), long forearm (40.1–45.7), large skull (greatest length 22.1–24.2), and long toothrows (maxillary toothrow 7.8–8.5).

DISTRIBUTION.—Known presently from the Lesser Antillean islands of Anguilla, Barbuda, Antigua, Dominica, and St. Lucia (see fig. 1).

REMARKS.—At the time of its description, *M. plethodon* was compared only with the then-named kinds of *Monophyllus—M. redmani*, *M. portoricensis*, and *M. clinedaphus*. The dental peculiarities (primarily the crowding of the upper premolars) used to distinguish *M. plethodon* from these other taxa do indeed distinguish it from these Greater Antillean bats. When *M. luciae* was named (on the basis of 16 specimens), it was compared with *M. plethodon* and was said to differ from the latter in being larger (which apparently it is) and in having less crowded teeth. The teeth of our Barbadian specimen, although crowded as typical of the species, are no more closely appressed than in specimens from St. Lucia, Dominica, or other Lesser Antillean islands. Since there are no skins available from St. Lucia,

we do not know if there are color differences between topotypical *M. p. luciae* and *M. p. plethodon*, but we are inclined to doubt that such occur.

Mensural data for three samples of *M. p. luciae* are presented in tables 1 and 2. External measurements are available only from our large series from Dominica, but comparison with those of isolated bats from other islands indicates no difference in size. Means and extremes of cranial measurements for the three different populations of *M. p. luciae* are quite comparable; some measurements (condylobasal length, zygomatic breadth, maxillary toothrow) intimate the existence of a cline, with larger bats in the north, but others (greatest length of skull, postorbital constriction, mastoidal breadth) do not demonstrate this phenomenon clearly, if at all. There is no evidence in bats from the northern part of the range of *M. p. luciae* of a trend in size toward the much smaller, geographically adjacent *Monophyllus redmani portoricensis*.

Two specimens of *M. p. luciae* (KU 104779, gravid ♀; USNM 361897, ♀) from Dominica are distinctly paler dorsally than other bats from that island. Instead of being the medium to dark brown of all other *M. p. luciae*, these two bats are pale buffy tan above and only slightly darker (more grayish) below. No other sample of *M. redmani* or *M. plethodon* shows such variation. The mentioned differences in color could be due to dichromatism in the population on Dominica or to change in color of the pelage relating to wear and fading.

Monophyllus has not been reported previously from the islands of Antigua and Barbuda. The specimen from Barbuda was collected by P. W. Hummelinck, and his notes state that the bat was found dead near the entrance of Dark Cave. Dark Cave is situated at the bottom of a wooded sinkhole and is about 170 meters long and has three water-filled basins. No other bats of any species were observed in the cave. The four Antiguan *M. p. luciae* were collected in Bat Cave near English Harbour. Both the caves on Antigua and Barbuda are located in xeric regions.

Howes (1930, pp. 102–103) reported taking *Monophyllus* in a cave at Dleau Manioc near the Layou River on Dominica; the cave entrance lay about 200 feet (61 meters) up on the face of cliffs bordering the river. Howes' report of this bat from Dominica has been overlooked by other workers. Of 16 *M. p. luciae* collected by the junior author on Dominica, six were netted in banana groves, four were taken in nets across a trail that separated woodlands from a *Theobroma* grove, and others in a net stretched across part of the Layou River. One individual was netted in a banana grove at Marigot. A male was found dead adjacent to a small cave a few yards from the ocean near

Mahaut. The single specimen taken by the senior author was captured in a mist net stretched across a montane stream in dense rainforest. Elevations of known occurrence of *M. p. luciae* range from sea level up to approximately 1800 feet (550 meters); these extremes are from Dominica material.

Bats taken in nets that also contained *M. p. luciae* on Dominica include *Artibeus jamaicensis*, *Brachyphylla cavernarum*, *Sturnira angeli*, *Myotis nigricans*, and *Ardops nichollsi*. There are no data on associated species from situations wherein *Monophyllus* has been collected on other Lesser Antillean islands.

Females collected on Dominica by the junior author between Mar. 24 and Apr. 22, 1966, were gravid; foetuses varied in length from 17 to 24, with larger foetuses occurring on the later dates. Males during the same period had testes 4 to 4.5 in length. Only one young is born to a female. Weights of males ranged from 13.8 to 17.2; those of females from 12.5 to 17.0, with the single nongravid female weighing the least.

SPECIMENS EXAMINED.—ANGUILLA: Small Fountain Cave, Little Bay, 1 ♀ (AMNH 72367). BARBUDA: Dark Cave, 1 ♀ (RMNH 17854). ANTIGUA: Parish of St. Paul: Bat Cave, 4 ♂ (BMNH 18.4.1.7–.9, MCZ 17468). DOMINICA: St. Joseph Parish: Clarke Hall Estate, 100 ft, 7 ♂, 10 ♀ (KU 104766–79, USNM 361896, 391225, 391275); St. Paul Parish: Sylvania, 1 ♀ (USNM 361897); 1½ miles northwest of Mahaut, sea level, 1 ♂ (KU 104780); 6 miles northeast of Roseau, 1100 ft, 1 ♀ (AS 5357); St. Andrew Parish: Marigot, 100 ft, 1 ♀ (KU 104765); St. Lucia: no specific locality, 2 ♂, 11 ♀ (USNM 106090–94, 106098–100, 110901–05).

Monophyllus plethodon frater Anthony

Monophyllus frater Anthony, 1917, p. 565. [Type-locality: cave (Cueva Catedral) near Morovis, Puerto Rico.]

DISTRIBUTION.—Known only as fossil from Puerto Rico (see fig. 1).

REMARKS.—*Monophyllus plethodon frater* was described from five fragmentary skulls; the species was differentiated from *M. r. portoricensis* by its larger size. Anthony (1918, p. 350) commented:

> This large species of *Monophyllus* was apparently contemporaneous with *M. portoricensis* . . . since a typical skull of the smaller *portoricensis* was found in the same deposit with the skulls of *frater*. It is partly for this reason that *frater* has been accorded full specific rank instead of being placed in the line of direct ancestry of *portoricensis* . . . . The relationship with *portoricensis* is very close however and the differences appear to be in size rather than detail. Were the two forms from adjacent islands rather than from the same island doubtless they would best be considered subspecifically related . . . . *M. frater* is probably even more closely related to the larger *M. luciae* from the Island of St. Lucia, Lesser Antilles, than to the small *portoricensis* . . . . Compared with *M. luciae*

the fossil *Monophyllus* may be distinguished by its rather longer rostrum and noticeably longer toothrow.

We have examined three fragments of *M. frater*, including two rostra and one palate. As in other representatives of *M. plethodon*, the diastema between the upper premolars is narrow; the first upper premolar is lacking in the three fragments, but its alveolus and either the alveolus of the second premolar or the tooth itself clearly demonstrate that the two upper premolars were appressed as in the Lesser Antillean *M. plethodon*. There is no question that *M. frater* is related to *M. plethodon* rather than to the Greater Antillean *M. redmani*.

We use a trinomial to show the close affiliations of *M. frater* with *M. plethodon*. There are those who feel that such usage is inappropriate for nonsynchronous taxa. We do so here for three reasons: (1) Although no large *Monophyllus* has been taken in the flesh on Puerto Rico, there is a good possibility that *M. p. frater* may be so encountered. Several other Antillean mammals (*Brachyphylla nana* and *Capromys nana* in Cuba, and *Brachyphylla pumila* on the island of Hispaniola) were named originally from fragmentary cave material and were later secured in the flesh. (2) *Monophyllus r. portoricensis* and *M. p. frater* were apparently at least partially contemporaneous in Puerto Rico, suggesting that the latter species is a relatively recent inhabitant of the island rather than an ancient arrival. Anthony (1918, p. 338), writing specifically about the Cueva Catedral fossils, concluded that "the fossil bats of Cueva Catedral have been fossil for no lengthy period" and that, considering the Puerto Rican fossil fauna as a whole, a "conservative estimate would place the island mammalia as living at the end of the late Pleistocene and there is little doubt that this age may be extended into the Recent." (3) Use of a trinomial clearly shows the close relationship of *M. frater* with the other subspecies of *M. plethodon*. Maintaining two distinct species obscures their obvious affinities.

Anthony's (1918, p. 350) brief comparison of *M. frater* with *M. luciae* (that the former differs from the latter in having a "rather longer rostrum and noticeably longer tooth row") seems to be affirmed by recently acquired specimens of *M. p. luciae* although, considering the total variation in *luciae*, the differences are far from striking. Anthony's measurements (1918, p. 350) of "interorbital breadth" (4.6–4.9 in three *M. frater*) fall within the known variation of our measurements of postorbital breadth in *M. luciae* (4.5–5.0) and above those of *M. redmani* (3.8–4.6 in all subspecies, with *M. r. redmani* most closely approaching the measurements of *M. p. frater*). The alveolar length of the upper molariform series of two *M. p. frater* measures 6.8 and 7.1, quite comparable to similar measurements in other *M. plethodon*. It is even possible that *M. p. frater* is not

worthy of recognition as an entity distinct from *M. p. luciae*. We are deterred from so considering *M. p. frater* by the fact that all skulls are incomplete, usually grossly so, and by the lack of specimens on which pelage characters and external measurements can be ascertained. We therefore retain *M. p. frater* with full knowledge that it may prove later to be synonymous with *M. p. luciae*. Retention of the name at this time permits its convenient use in dealing with the larger of the two species of *Monophyllus* from Puerto Rico.

SPECIMENS EXAMINED.—PUERTO RICO: Cueva Catedral, Morovis, Arecibo, 3 (AMNH 40942–44).

Discussion

The genus *Monophyllus* is composed of two species, each with three subspecies, which, except for the sympatric occurrence of representatives of each species on Puerto Rico, are allopatric. One species (*M. redmani*) is Greater Antillean in distribution and the other (*M. plethodon*) is Lesser Antillean, except for the occurrence (only in the past?) of a population on the island of Puerto Rico. Such a picture suggests that there have been two independent centers of differentiation of *Monophyllus* in the West Indies with the resultant evolution of two practically allopatric species. The Lesser Antillean *M. plethodon*, however, succeeded in crossing the Anegada Passage and reached Puerto Rico at a time when that island was occupied also by *M. redmani*. Clear evidence of immigration from the Lesser Antilles to the Greater Antilles (in contrast to the reverse situation) is quite rare in the terrestrial vertebrate biota of the Antillean islands, and *M. plethodon* stands out as an invader of the Greater Antilles from the south.

The degree of differentiation of the subspecies of *M. redmani* (in contrast to those of *M. plethodon*) is striking. The races of *M. redmani* (*M. r. redmani*, *M. r. clinedaphus*, *M. r. portoricensis*) all are distinctly different, the primary difference being in overall size and concomitantly in size of skull. Although perhaps interpretable as grossly clinal, with the largest subspecies in the west (*M. r. redmani*) and the smallest in the east (*M. r. portoricensis*), the size difference is not quite so diagrammatically demonstrated as one might assume from first glance. The subspecies *M. r. redmani* and *M. r. clinedaphus*, for instance, have comparably long forearms despite a distinct dichotomy in overall size; secondly, the occurrence of *M. r. clinedaphus* on two islands (Cuba and Hispaniola), rather than each island having its own subspecies, suggests also that we are not dealing with variation of a typically clinal nature.

In contrast to the subspecific differentiation in *M. redmani*, the races of *M. plethodon* are much less distinctly defined. In fact, were

it not for the small holotype of *M. p. plethodon* and temporal considerations of *M. p. frater*, we would be prone to consider *M. plethodon* as monotypic. The limited material of topotypic *M. p. plethodon* and *M. p. frater*, plus the fact that the latter is known only from fragmentary skulls, make assessment of the status of the Barbadian and Puerto Rican subspecies extremely difficult. The geographic isolation of Barbados from the balance of the Lesser Antillean chain and the presence of an apparently isolated segment of *M. p. plethodon* in Puerto Rico have been decisive factors in our retention of these two populations as distinct from the main body of Lesser Antillean *M. p. luciae*. Lack of presently demonstrable differences between the populations of *M. p. plethodon* on the Lesser Antillean islands of St. Lucia, Dominica, Antigua, Barbuda, and Anguilla suggests that the species is relatively stable genetically (a suggestion somewhat confirmed by the small differences among the subspecies *M. p. plethodon*, *M. p. luciae*, and *M. p. frater*), or that there is intercourse between populations of *M. p. plethodon* on the various Lesser Antillean islands (although as yet *Monophyllus* remains unknown from any two adjacent islands except Barbuda and Antigua on the same bank), or that *M. p. plethodon* is a relatively recent arrival on at least some of the Lesser Antillean islands, which it now occupies without sufficient elapsed time for local subspecific differentiation. The latter seems to us to be the most acceptable interpretation. Doubtless, additional collecting will reveal the presence of *M. plethodon* on at least those Lesser Antillean islands (Martinique, Guadeloupe, and the islands of the Anguilla Bank) that lie either between known stations of occurrence of the species or on the same bank as islands from which *M. plethodon* is known.[3] The French islands in particular are poorly explored mammalogically.

The complete dichotomy of *M. plethodon* and *M. redmani* in the one character that distinguishes them—the diastema between the upper premolars—makes any analysis of relationships, history, and loci of origin extremely difficult. The general concordance in size of *M. plethodon* and *M. r. redmani* suggests that the latter is the subspecies of *M. redmani* most closely related to *M. plethodon*. This indeed may be the case, but *M. r. redmani* occupies that island (Jamaica) in the range of the species that is farthest removed from the present distribution of *M. plethodon*. Perhaps *M. r. redmani* was an early fortuitous arrival in Jamaica from the Lesser Antilles. Data presented by Koopman and Williams (1951), however, suggest that *M. redmani* arrived relatively recently on Jamaica although Williams (1952)

[3] After this paper was submitted for publication, a specimen of *M. plethodon* was collected on St. Vincent by a field party from the Museum of Natural History, University of Kansas.

reported finding *Monophyllus* as a fossil on the island. Absence of *Monophyllus* from earlier Jamaican fossiliferous deposits may be due merely to the chance nature of such deposits themselves.

Once established on Jamaica, *M. redmani* could thus have extended its distribution to Hispaniola (*M. r. clinedaphus*) and still further to Puerto Rico (*M. r. portoricensis*). Since Hispaniola and Cuba both are inhabited by *M. r. clinedaphus*, we suggest that Cuba was the last island of the Greater Antilles to be invaded by *Monophyllus*, that these invaders came from Hispaniola to the east rather than from Jamaica to the south, and that there has been little or no subsequent divergence of the Cuban populations of *M. r. clinedaphus* from their Hispaniolan forebearers.

Meanwhile, in the Lesser Antilles, *M. plethodon* became established on some of the Windward Islands from a center of origin there. Any of the mountainous inner chain of islands would seem a suitable locus for the origin and center of dispersal of *M. plethodon:* Dominica or Guadeloupe, both near the central portion of the Lesser Antillean arc, might have been the region whence *M. plethodon* colonized the balance of these islands. From this Lesser Antillean center, *Monophyllus* reached Barbados (*M. p. plethodon*) on one hand and Puerto Rico (*M. p. frater*) on the other, while the parent populations (*M. p. luciae*) remained in situ on the Windward and Leeward Islands. Although this suggested history may bear little resemblance to the sequence of events as they really occurred, it offers at least a tentative explanation that appears to do little violence to the relationships and distribution as currently understood.

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1	Kier	Echinoids	1966	121	3577
2	Stone	Diptera: Anisopodidae, Bibionidae	1966	121	3578
3	Kirsteuer	Marine archiannelids	1967	123	3610
4	Allen	Hymenoptera: Tiphiidae	1967	123	3617
5	James	Diptera: Stratiomyidae	1967	123	3622
6	Jones and Schwartz	Bats of genus *Ardops*	1967	124	3634

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Four New Fishes of the Genus *Parapercis* with Notes on Other Species from the Indo-Pacific Area (Family Mugiloididae)

By Leonard P. Schultz

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Four New Fishes of the Genus *Parapercis* with Notes on Other Species from the Indo-Pacific Area (Family Mugiloididae)

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Mugiloidid fishes of the genus *Parapercis* from the International Indian Ocean Expeditions (IIOE), 1964, the Te Vega Expeditions (TVE), 1963 and 1965, and the Smithsonian Institution Pacific Ocean Biological Survey (SIPOBS), 1964, together with other specimens in the United States National Museum form the basis of this paper. Among this material four new species were discovered and are described herein.

Dr. George E. Cantwell (1964), who revised the genus *Parapercis*, recognized 26 species. Not included in Cantwell's analysis of species are *P. okamurai* Kamohara (1960) and *P. kamoharai* Schultz (1966).

Dr. Chuichi Aranga (Seto Marine Biological Laboratory, Japan), who collected the types of *P. kamoharai*, informed me through correspondence that the type-locality was incorrect as published. He writes that he collected the types on the "Southwest Coast of Kii Peninsula, Wakayama Prefecture, south of Osaka Prefecture. This species inhabits the coastal waters, but it has never been collected from the inner part of any bay."

Parapercis okamurai Kamohara is very close to *P. aurantiaca*, both having palatine teeth, whereas all the new species described herein lack palatine teeth.

Since the recently discovered new species were unknown when Cantwell made his revision (loc. cit), I have extensively expanded and modified his "Key to the Species of *Parapercis*." Differences in counts between the two keys result from new counts by me, the correction of a few errors in the Cantwell key, and additional color descriptions. The following key distinguishes 32 species.

Key to the Species of *Parapercis*

1a. Palatine teeth present.
2a. 10 teeth in outer row of lower jaw.
3a. Total anal rays 19; soft dorsal fin rays 22; no dark spot at tip of chin; front of premaxillary plain brownish but lighter just laterally; side of upper lip with 2 small brown spots (southern and western Australia). **hanckei** (Steindachner)
3b. Total anal rays 18; soft dorsal fin rays 21, rarely 22; dark spot at tip of chin; front of premaxillary with 3 brown-edged light cross bars; side of upper lip plain brown (Great Barrier Reef, Queensland, Australia, northward to Ryukyu Islands; Marshall and Fiji Islands). **cylindrica** (Bloch)
2b. 6 or 8 teeth in outer row of lower jaw.
4a. 6 teeth in outer row of lower jaw.
5a. 7–13 dark bars on upper side.
6a. Midbase of caudal fin with dark spot; brown-edged light bar across nape, interrupted at middorsal line by narrow brown isthmus; 10 narrow dark bars on upper side, one below spiny dorsal and 8 below base of soft dorsal (Japan, Korea, Formosa, and Hawaiian Islands). **multifasciata** Steindachner and Döderlein
6b. Midbase of caudal fin without dark spot; no light bar across nape.
7a. 13 narrow dark bars on upper side, 2 under spiny dorsal and 9 under base of soft dorsal fin (New South Wales, Australia) . . **binivirgata** (Waite)
7b. 7 broad dusky bars on upper side, sometimes absent after long preservation, with 5 of the bars under base of spiny and soft dorsal fins (Japan to Formosa) . . . . . **aurantica** Steindachner and Döderlein
5b. No dark bars on upper side or on back, coloration plain light yellowish; black spot at dorsal base of caudal fin; few small black spots above base of pectoral fin, pectoral axil blackish; few small black specks along anterior part of lateral line (Japan) . . . . . **okamurai** Kamohara
4b. 8 teeth in outer row of lower jaw.
8a. Dorsal fin spines longest posteriorly.
9a. Total pectoral rays 16 or 17; scales in zigzag row around caudal peduncle 30–34; 5 V-shaped dark bars on upper side; dorsal base of caudal fin with large black spot (Japan, Korea, Formosa to South China Sea). **sexfasciata** (Temminck and Schlegel)
9b. Total pectoral rays 19; scales in a zigzag row around caudal peduncle 27; no V-shaped dark bars on upper side; base of caudal fin without distinct large black spot; upper side tesselated in color pattern (Japan). **mimaseana** (Kamohara)
8b. Dorsal fin spines longest at middle of fin.

10a. Last dorsal fin spine connected by membrane to base of first soft dorsal ray; 5 dark V-shaped bars on upper side, 1 under spiny dorsal, 4 under soft dorsal; pectoral fin base with a black spot (Korea; Japan to Formosa). **snyderi** Jordan and Starks

10b. Last dorsal fin spine connected by membrane to first soft dorsal fin ray opposite tip of last dorsal spine.

11a. Dorsal fin rays IV,24; total pectoral fin rays 16; oblique scale rows 60–64; scales above lateral line 4 (New South Wales and South Australia). **ramsayi** Steindachner

11b. Dorsal fin rays V,23; total pectoral fin rays 20; oblique scale rows 50–54; scales above lateral line 6 (Japan and Formosa) . . **muronis** (Tanaka)

1b. Palatine teeth absent.

12a. 6 teeth in outer row of lower jaw.

13a. Last dorsal fin spine connected by membrane to base of first soft dorsal ray.

14a. Dorsal fin rays V,21 rarely 22; total anal rays 18, rarely 19; upper and lower caudal fin rays greatly elongated, with brownish coloration (Hawaiian and Seychelles Islands) . . . . . **schauinslandi** (Steindachner)

14b. Dorsal fin rays V,22; total anal rays 19; no caudal fin ray greatly elongated.

15a. Oblique rows of scales above lateral line 56–62; scales above lateral line to first soft dorsal ray 4 or 5 with 13–15 below to anus; zigzag row of scales around caudal peduncle 24–30.

16a. Total pectoral rays 16; zigzag row of scales around caudal peduncle 26–30; total gill rakers 9–12; anterior rays of soft dorsal fin greatly elongated (Singapore and Hainan) . . . . . **filamentosa** (Steindachner)

16b. Total pectoral rays 17–19; zigzag row of scales around caudal peduncle 24–26; no soft ray of dorsal elongated.

17a. Total pectoral fin rays 18 or 19; gill rakers 6 or 7+12–16=19–23 (Arabian Sea, Bay of Bengal, Andaman Sea, Misoöl Island [2°S 130°E], Philippines, and China Sea) . . . . . **alboguttata** (Günther)

17b. Total pectoral fin rays 17; gill rakers 4 or 5+9 or 10=14 or 15 (Somali coast and Red Sea) . . . . . **simulata,** new species

15b. Oblique rows of scales above lateral line 70–83; scales above lateral line to base of first soft dorsal ray 8–10, and below lateral line to anus 20–24; zigzag row of scales around caudal peduncle 35–44.

18a. Total gill rakers 17–20; oblique scale rows above lateral line 70–77; 3 dark stripes across interorbital space; 5 V-shaped dark bars below dorsal fins, but no broad, light, lengthwise streak with dark edge along middle of side, interrupting the dark bars (Bustard Head, Queensland to Dampier Archipelago, Western Australia) . . . . . **emeryana** (Richardson)

18b. Total gill rakers 11–17; oblique scale rows above lateral line 77–87; no dark stripe in interorbital space; dark bars somewhat V-shaped below dorsal fins, interrupted along middle of side by dark-edged, broad, light streak (Durban, Natal, Persian Gulf, Madagascar, off Somali, Reunion, West Australia, Queensland, and New South Wales). **nebulosa** (Quoy and Gaimard)

13b. Last dorsal fin spine connected by membrane to first soft dorsal ray opposite tip of last dorsal spine.

19a. 4 dorsal fin spines.

20a. Small intense black spot in each of 9 vertical bars on side along lengthwise line just below midside; black ocellate spot just above opercle; midcaudal fin rays occasionally with white area in basal half; snout in front of eyes notably brown spotted; anal fin distally with single series

of small dark spots (Philippines, Marshalls, Gilberts, East Indies, Samoa, Fiji Islands, Carolines) . . . . . **clathrata** Ogilby

20b. No small black spots in dark vertical bars on side of body as in *clathrata;* no black above opercle; middle caudal fin rays with white blotch in distal half of fin; snout without brown spots; no row of brown spots distally on anal fin (Philippines, Marianas, Marshalls, Gilberts, Fiji Islands, Ceylon, Ryukyu Islands, East Indies, Carolines, Mauritius, and off Thailand). . . . . **cephalopunctata** (Seale)

19b. 5 dorsal fin spines.

21a. Zigzag row of scales around caudal peduncle 26–32.

22a. Oblique scale rows 55–64.

23a. Large dark ocellate spot above operculum and above lateral line; exposed distal part of each soft anal ray dusky; dark vertical bars on sides meeting at midventral line of body (Japan to East Indies, Samoa, Fiji Islands, Bay of Bengal, Cocos Islands) . . . . . **tetracantha** (Lacepède)

23b. No dark ocellate spot as in *tetracantha;* exposed distal tips of soft anal rays unpigmented; dark vertical bars on sides not continuing to midventral line of body (Japan to Queensland, Fiji Islands, Zanzibar, Madagascar). **xanthozona** (Bleeker)

22b. Oblique scale rows 66–72; cheeks and rear of head with conspicuous light and dark cross-bars; side of body with 7 light bars ending in 7 black ocellate spots on lower side, leaving belly plain light tan; 7 scales from base of first soft dorsal ray to lateral line (Japan) . **kamoharai** Schultz

21b. Zigzag row of scales around caudal peduncle number 24–26.

24a. Oblique scale rows 51–55, with 4 scales above lateral line to base of first soft dorsal ray and 12–13 below lateral line to anus; gill rakers 5 or 6+9 or 10 on first arch (off coast of Somali) . . . **somaliensis,** new species

24b. Oblique scale rows 56–62, with 5 scales above and 13 or 14 below lateral line; gill rakers 6+9 or 10 on first arch.

25a. 2 dark bars across belly between bases of pelvic fins and anus; no dark spot on side of body below depressed pectoral fin (Seychelles Islands). **bivittata,** new species

25b. No dark bars across belly; 3 dark ocellate spots in row on side in area between depressed pectoral fins and that of pelvic fins (Seychelles Islands). **trispilota,** new species

12b. 8 teeth in outer row of lower jaw.

26a. Dorsal fin spines longest posteriorly; caudal vertebrae 18.

27a. Dorsal rays V(rarely VI),20; total anal rays 17, occasionally 18; scales above lateral line 10–12; total gill rakers on first arch 21–26; brownish pigment at base of pectoral fin (New Zealand, Chatham, and Alderman Islands) . . . . . **colias** (Bloch)

27b. Dorsal rays V,21; total anal rays 18; scales above lateral line 4–7; total gill rakers on first arch 15–20; base of pectoral fin without brown coloration.

28a. Oblique scale rows 60–65; zigzag scales in row aröund caudal peduncle 25–29; scales in row from lateral line to anus 16 or 17, and above lateral line 4 or 5 (New South Wales, South Australia, Tasmania). **allporti** (Günther)

28b. Oblique scale rows 65–69; zigzag scales in row around caudal peduncle 30–34; scales in row from lateral line to anus 18 or 19, and above lateral line 6 or 7 (New Zealand) . . . . . **gilliesi** (Hutton)

26b. Dorsal spines longest at middle of fin; caudal vertebrae 19.

29a. Membrane from last dorsal fin spine connects at base of first soft dorsal ray; no large black blotch on middle rays of caudal fin.

30a. Dorsal fin rays V,21, occasionally 22; total anal rays 18, occasionally 19; total pectoral rays 16 or 17; scales from lateral line to anus 14–17, and above lateral line 4–6; no black spot on caudal fin base (Japan to China Sea, Comores, east coast of Africa to Durban, Zanzibar).
pulchella (Temminck and Schlegel)

30b. Dorsal fin rays V,22; total anal rays 19, rarely 20; total pectoral rays 14 or 15, rarely 16; scales from lateral line to anus 10–13 and above lateral line 3, rarely 4; black spot at base of upper lobe of caudal fin (Korea, Japan to Formosa, Hong Kong) . . . . . **ommatura** Jordan and Snyder

29b. Membrane of spinous dorsal connects with first soft dorsal ray opposite tip of last dorsal spine; large black blotch on middle rays of caudal fin.

31a. 2 or 3 lengthwise rows of brown spots on cheek; 5–7 dark ocellate spots in a row along ventral side of body (Okinawa; Phillppines; Rennell Islands; Ryukyu Islands; New Caledonia; east coast Africa; Zanzibar; Red Sea).
polyophthalma (Cuvier and Valenciennes)

31b. 4–8 oblique dark lines across cheek; 3–5 dark ocellate spots in a row along ventral side of body (North China and Ryukyu Islands south to Northern Australia, east to Fiji Islands, westward to Red Sea, and south to Durban).
hexophthalma (Cuvier and Valenciennes)

Parapercis simulata, new species

PLATE 1

HOLOTYPE.—USNM 200760, Somali Coast, lat. 11°4′N, long. 51° 15′E, Dec. 17, 1964, IIOE, *Anton Bruun* Cruise 9, Sta. 451, depth 76–80 meters, standard length 150 mm.

PARATYPES.—USNM 200761, same data as holotype, 11 spec., 121–146 mm. USNM 200759, Somali Coast, 11°11′N 51°14′E, Dec. 17, 1964, IIOE, *Anton Bruun* Cruise 9, Sta. 453, depth 47–49 meters, 2 spec., 118 and 126 mm. USNM 250258–F19, Red Sea, Safaga, Egypt, Feb. 9–10, 1964, otter trawl, collector C. J. D. Brown, 1 spec., 143 mm.

DESCRIPTION.—Measurements made on the holotype and 7 paratypes are recorded in table 1. Counts for the holotype and paratypes are recorded in tables 2 to 4.

Teeth present on vomer, absent on palatines; 6 hooked canine teeth (3 on each side) at tip of lower jaw; spinous dorsal fin connected by membrane at base of first soft ray; pectoral rays 9 to 11 (counted from dorsal edge) longest; fourth soft pelvic ray longest; upper caudal fin rays longest and sometimes projecting as a free ray as much as diameter of pupil; scales in a zigzag row around caudal peduncle 24–26.

COLOR IN ALCOHOL.—General background of head and body straw colored, with edges of scales dusky on sides giving a netlike appearance; on lower side dark pigmentation on scale edges intensified to form 5 evenly spaced dusky bars; sometimes there is intensification of pigment on edges of about two vertical scale rows in each area between the 5 larger dusky blotches; belly plain light straw colored;

dusky bar from eye to snout tip; 2 dusky bars from eye across preorbital and maxillary, another dark bar with light center from lower rear of eye downward to corner of mouth, and a dusky pale centered bar across preopercle; all bars separated by light areas; inner rays of pelvic fins blackish; dorsal three-fourths of base of axil of pectoral fin dusky; dark spot near base of middle rays of upper lobe of caudal fin, and sometimes a less intense dark spot in lower lobe in a similar position; caudal fin and posterior soft dorsal rays lightly marked with dusky bars; pectoral and anal fin rays unmarked.

TABLE 1.—*Measurements made on two species of* Parapercis *expressed in thousandths of standard length*

Characters	*P. alboguttata*								*P. simulata*, new species							
	USNM 200693			USNM 200697					Holotype USNM 200760	Paratypes USNM 200761						
Standard length (in mm)	165	136.5	121.5	167	145	119	118.5	117	150	153	153	138	133	130	125	121
Length of head	306	298	317	344	331	322	331	316	287	289	307	290	297	277	297	294
Length of snout	108	98	101	121	114	101	110	94	109	110	108	95	105	100	107	94
Diameter of eye	81	75	82	74	70	79	76	76	69	63	62	77	69	73	73	70
Postorbital length of head	127	131	135	156	161	151	154	149	137	127	130	135	132	123	126	137
Width fleshy interorbital space	42	48	41	69	60	67	49	51	43	56	60	47	43	42	44	41
Snout tip to rear edge maxillary	128	117	123	144	137	124	132	122	120	124	132	111	120	118	116	116
Width of preorbital	50	43	45	63	58	44	53	43	51	50	55	47	50	48	48	41
Least depth of body	63	67	75	62	64	60	63	58	79	75	80	76	79	78	78	75
Greatest depth of body	185	150	165	174	159	162	180	144	177	170	173	174	173	177	174	174
Length fourth dorsal spine		81	77	94	86	91	93	75	87	86	90	85	83	82	90	92
Longest pectoral ray	158	160	173	158	159	166	164	165	157	164	168	167	177	180	160	163
Longest pelvic ray	173	183	189	177	200	181	207	190	191	196	189	203	196	213	200	202
Longest caudal ray	162	161	165	201	204	193	211	172	185	186	202	191	184	206	195	196
Length base of dorsal fin	642	655	626	623	586	621	595	560	646	612	638	674	648	646	684	634
Length base of anal fin	482	458	465	473	469	454	451	418	494	488	483	467	478	485	468	496

DISCUSSION.—This new species was collected at depths between 47 and 80 meters and at an unknown depth in the Red Sea. It is closely related to *P. alboguttata* Günther, type-locality of which is Misoöl Island, about lat. 2°S and long. 130°E, off the western tip of New Guinea. Cantwell (1960, p. 258) reports it from Muscat, Monja Island, China Sea. *Neopercis tesselata* Herre from Manilla Bay, without palatine teeth, was placed in the synonomy of *P. alboguttata* by Cantwell, with which opinion I agree on the basis of a radiograph showing i,17 pectoral rays instead of i,16 as found in *P. simulata*, new species.

Fortunately, the IIOE collected a fine series of specimens of *P. alboguttata* from the Arabian Sea and the Bay of Bengal. A comparison of *P. alboguttata* with *P. simulata* reveals that although the color patterns of the two species are nearly identical, they differ in regard to the following characters: In table 2, it can be observed that *P. alboguttata* almost always has i,17 and i,18 pectoral rays while, in table 3, the gill rakers number 6–9 + 12–15 = 19–23, whereas *P. simulata* has i,16 pectoral and 4 or 5 + 9 or 10 = 13–15 gill rakers respectively. In the genus *Parapercis*, a difference in total number of gill rakers from 13 to 15 compared with 19 to 23 with no overlap in the range is highly significant and indicates in my opinion two distinct species.

An examination of the measurements recorded in table 1 indicates that *P. alboguttata* is a more slender species (least depth of caudal peduncle 58–75, average 64, thousandths; greatest depths 144–180, average 161) than *P. simulata*, (75–80, average 77.5, and 170–177, average 174). In addition, *P. simulata* has a shorter head (277–307, average 292 thousandths of length), smaller eye (62–73, average 69.5), and shorter mouth (snout tip to rear of maxillary 111–132, average 120), whereas in *P. alboguttata* these figures are, respectively, 298–344, average 321; 70–82, average 77; and 117–144, average 128.

In table 5, a comparison of certain body proportions was made and the data in this table shows that the least depth of body into head length is 3.5–4.0 for *P. simulata* and 4.1–5.6 for *P. alboguttata*, and, respectively, for least depth of body into eye, 0.8–1.0 and 1.1–1.3.

Since *P. alboguttata* is known now to range from the China Sea to Muscat in the northern Arabian Sea, it may be thought that *P. simulata* may represent a subspecies of *P. alboguttata*. There was no variability, however, in counts or measurements for *P. alboguttata* that indicated a morphocine or any other data that might be correlated with range.

Other distinct species of fish have identical or nearly identical color patterns: *Paramia quinquelineata* (Cuvier and Valenciennes) and

TABLE 2.—*Frequency distribution of number of soft fin rays recorded for certain closely related species of* Parapercis (x=range of counts from Cantwell, 1964)

Species	Dorsal		Anal				Pectoral				
	21	22	15	16	17	18	1,14	1,15	1,16	1,17	1,18
trispilota	12				12			3	20	1	
bivittata	3	1			3			2	5	1	
schaunislandi											
Hawaii	4				4			7	1		
Seychelles	3				3		2	4			
somaliensis	3				3				6		
alboguttata		20				20			2	69	37
simulata		14				14			25	3	
xanthozona	x				x			x	x		
kamoharai	2		1		1				3	1	

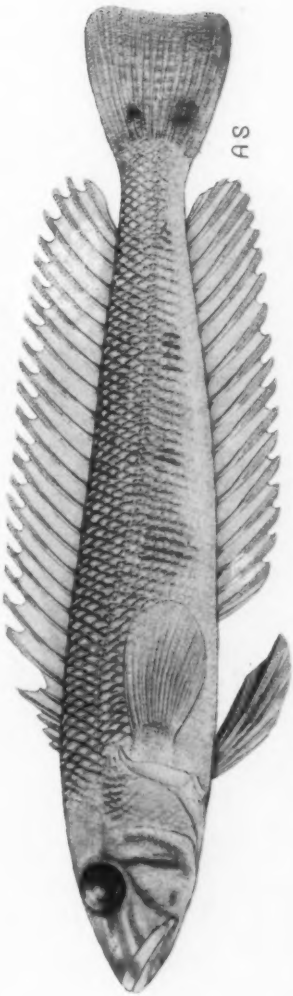
TABLE 3.—*Frequency distribution of number of gill rakers recorded for certain closely related species of* Parapercis (x=range of counts from Cantwell, 1964)

Species	Upper Arch						Lower Arch								Total										
	4	5	6	7	8	9	7	8	9	10	11	12	13	14	15	13	14	15	16	17	18	19	20	21	22	23
trispilota			7						3	4								2	5							
bivittata		2	1						3								2	1								
schaunislandi																										
Hawaii			3	1					3	1								3		1						
Seychelles		2					1	1	1							1	1									
somaliensis		2	1						1	2								1	1	1						
alboguttata			6	10	3	1						4	6	7	3							6	5	4	3	2
simulata	3	10							4	14						1	5	7								
xanthozona			x	x							x	x	x	x						x	x	x	x			
kamoharai			2							1	1								1	1						

TABLE 4.—*Frequency distribution of number of scales recorded for certain closely related species of* Parapercis (x=range of counts from Cantwell, 1964)

Species	Oblique rows																					
	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
trispilota						1	2	3	4	2												
bivittata								3	1													
schaunislandi																						
Hawaii									2	1	1											
Seychelles									1	1	1											
somaliensis	1	1			1																	
alboguttata										1	3	4										
simulata								1	3	4	2	1										
xanthozona					x	x	x	x	x	x	x	x	x									
kamoharai																1						1

Species	Above lateral line					Below lateral line to anus					
	4	5	6	7	8	12	13	14	15	16	17
trispilota		12					5	7			
bivittata		4				1		3			
schaunislandi											
Hawaii			4					3	1		
Seychelles		3					1	2			
somaliensis	3					2	1				
alboguttata	7	1					5	3			
simulata	4						7	3			
xanthozona			x	x	x		x	x	x	x	x
kamoharai				2					1	1	



Parapercis simulata, new species: holotype, USNM 200760 (drawn by Ann Schreitz).

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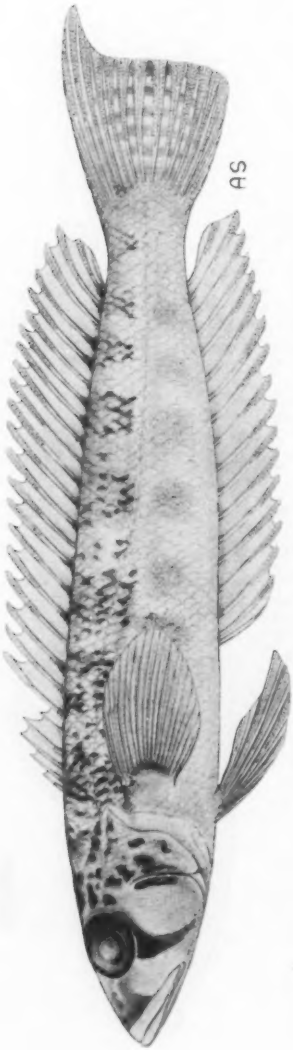
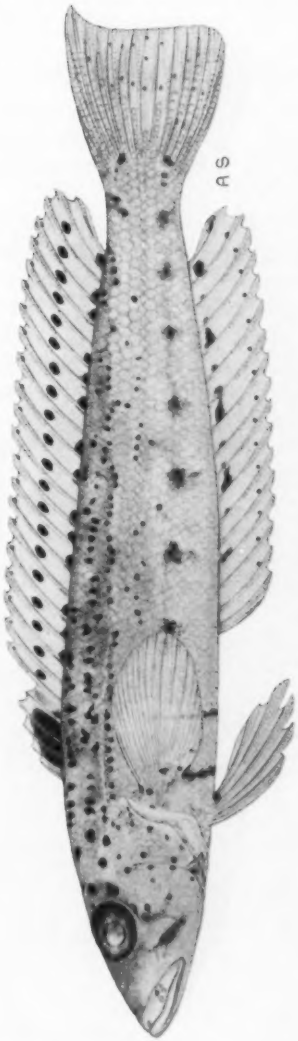
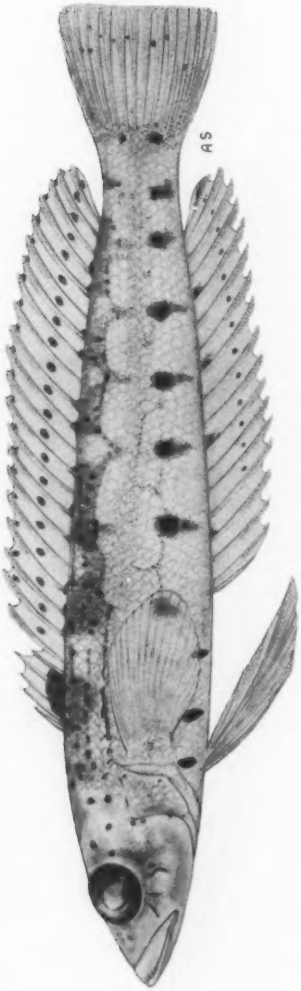


Parapercis somaliensis, new species: holotype, USNM 200751 (drawn by Ann Schreitz).



Parapercis bivittata, new species: holotype, USNM 200752 (drawn by Ann Schreitz).



Parapercis trispilota, new species: holotype, USNM 200721 (drawn by Ann Schreitz).

Cheilodipterops isostigma Schultz; also *Apogon nigrofasciatus* Lachner and *Apogon aroubiensis* Hombron and Jocquinot, among others.

The name "*simulata*" indicates that its color pattern is similar to that of its closest relative, *P. alboguttata*.

Parapercis alboguttata Günther

The following specimens, which were used for a comparison with *P. simulata*, new species, were collected by the International Indian Ocean Expedition during 1963 and 1964: USNM 200684, Nov. 17, 1963, Cruise 4B, Sta. 215A, 21°21′N 68°25′E, depth 123 meters, 1 spec., standard length 116 mm. USNM 200685, Dec. 17, 1964, Cruise 9, Sta. 9–456, off Somali Coast, 11°14′N 51°08′E, 1 spec., 138 mm. USNM 200686, Nov. 18, 1963, Cruise 4B, Sta. 219A, 21°52′N 68°6′E, 115 meters, 3 spec., 103–116 mm. USNM 200687, Nov. 15, 1963, Cruise 4B, Sta. 206A, 20°23′N 70°0′E, depth 71 meters, 6 spec., 103–136 mm. USNM 200688, Mar. 24, 1963, Cruise I, Sta. 22, 10°37′N 97°34′E, depth 96 meters, 1 spec., 125 mm. USNM 200689, Nov. 14, 1963, Cruise 4B, Sta. 202C, 18°27′N 71°13′E, 84 meters, 3 spec., 71–104 mm. USNM 200690, Mar. 30, 1963, Cruise I, Sta. 38, 14°7′N 97°5′E, 11 spec., 77–117 mm. USNM 200691, Mar. 30, 1963, Cruise 1, Sta. 37, 13°28′N 97°19′E, 1 spec., 118 mm. USNM 200692, Mar. 30, 1963, Cruise 1, Sta. 36A, 13°0′N 97°41′E, 3 spec., 110–121 mm. Photo of 121 mm specimen, USNM 200693, Mar. 24, 1963, Cruise 1, Sta.

TABLE 5.—*Comparison of frequency distributions of certain body proportions for* Parapercis simulata *and* P. alboguttata

Species	Least depth of body into head length											Least depth into eye					
	3.5 3.6	3.7 3.8	3.9 4.0	4.1 4.2	4.3 4.4	4.5 4.6	4.7 4.8	4.9 5.0	5.1 5.2	5.3 5.4	5.5 5.6	0.8	0.9	1.0	1.1	1.2	1.3
alboguttata				1		1	1		2	2	1				3	2	3
simulata	2	4	2									2	5	1			

Species	Greatest depth into length of upper jaw						Diameter of eye into longest pelvic ray										
	.60 .64	.65 .69	.70 .74	.75 .79	.80 .84	.85 .89	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1
alboguttata			1	3	2	2	1		2	2	1		1		1		
simulata	1	5	1	1								1	1	1	3	1	1

Species	Head into standard length							
	2.9	3.0	3.1	3.2	3.3	3.4	3.5	3.6
alboguttata	1	2	1	2	2			
simulata					1	5	1	1

Hydro. 21, 9°54′N 97°42′E, 5 spec., 117–163 mm. USNM 200694, Mar. 27, 1963, Cruise 1, Sta. 28A, 11°52′N 92°49′E, 1 spec., 89 mm. USNM 200695, Dec. 3, 1963, Cruise 4B, Sta 269A, 23°43′N 58°23′E, depth 49 meters, 1 spec., 142 mm. USNM 200696, Dec. 3, 1963, Cruise 4B, Sta. 269B, 23°33′N 58°23′E, depth 106 meters, 2 spec., 131 and 184 mm (photographed). USNM 200697, Nov. 14, 1963, Cruise 4B, Sta. 202B, 17°41′N 71°33′E, depth 90 meters, 29 spec., 94–167 mm.

Parapercis somaliensis, new species

PLATE 2

HOLOTYPE.—USNM 200751, off coast of Somali, depth 50–70 meters, Dec. 18, 1964, IIOE, Sta. 468, 11°52′N 51°14′E, standard length 105 mm.

PARATYPES.—USNM 200750, off coast of Somali, depth 67–72 meters, Dec. 18, 1964, IIOE, Sta. 465, 11°37′N 51°27′E, 2 spec., 81 and 120 mm.

DESCRIPTION.—Counts are recorded in tables 2–4 and measurements made on the holotype and paratypes are expressed in thousandths of the standard length in table 6.

Vomer with teeth, none on palatines; 6 canine teeth (3 on each side) near tip of lower jaw; spinous dorsal fin connected by membrane to first soft dorsal ray opposite tip of fifth dorsal spine; ninth branched pectoral ray from dorsal edge longest; upper caudal fin rays elongate, projecting as much as diameter of eye behind rear edge of that fin; scales in a zigzag row around caudal peduncle 24–26.

COLOR IN ALCOHOL.—Body with straw-colored background; dorsal half of body marked with 8 bars, and an additional bar crossing in front of dorsal fin; the checkered nature of these bars ends at a light streak along middle of the side, below which they continue as faintly pigmented bars not reaching base of anal fin; a pair of large brown spots near occiput; preorbital and snout brown, but not continuing on the premaxillary; a wedge-shaped brown bar below eye extending obliquely backward; preopercle light straw colored, except the posterior edge is brown; opercle brownish with about 4 dark brown spots; base of pectoral fin brownish posteriorly and anteriorly; pectoral, pelvic, and anal fins unmarked; dorsal fin rays with brown bases opposite the brown bars on upper sides; caudal fin with several light dusky cross bars.

DISCUSSION.—This new species traces down through Cantwell's (1964, p. 248) key to *P. xanthozona* but differs by having 5 or 6+9 or 10=14–16 gill rakers instead of 6 or 7+11–14=17–20 gill rakers as in *P. xanthozona*. *Parapercis somaliensis* has only 4 scales from lateral line to base of first ray of soft dorsal whereas *P. xanthozona* has 6–8.

Parapercis xanthozona has 6 small brown spots in a row across top of head behind eyes with a pair of small brown spots in front of the row behind interorbital space, whereas *P. somaliensis* has 6 large spots in a row across top of head behind eyes with the 2 spots at middorsal line greatly enlarged and no spots in front of the enlarged ones; the large dark spot just above the opercle in *P. xanthozona* is lacking in *P. somaliensis* or confined to a very intense and small black spot surrounding 2 pores. The series of dark spots on middle rays of caudal fin with a light unpigmented streak separating the spots in *P. xanthozona* are lacking in *P. somaliensis*. *Parapercis somaliensis* has a shorter snout and larger eye than *P. xanthozona* so that the preorbital is contained in the eye of *P. somaliensis* 1.8 to 2.1 instead of 1.1 to 1.4 in *P. xanthozona;* the preorbital into the postorbital is 1.5 to 1.8 instead of 1.9 to 2.2; the snout in head is 3.1 to 3.2 instead of 2.6 to 2.8, respectively.

The name "*somaliensis*" refers to the Republic of Somali off the shores of which this new species was collected.

Parapercis bivittata, new species

PLATE 3

HOLOTYPE.—USNM 200752, Seychelles Islands, south of Round Island, depth 12–15 meters, Feb. 22, 1964, IIOE Sta. F–61, standard length 114 mm.

PARATYPES.—USNM 200754, Seychelles Islands, Amirantes Islands, off north end Eagle Island, depth 6–9 meters, Mar. 4, 1964, IIOE Sta. F–85, 90 mm. USNM 200753, Seychelles Islands, Amirantes Islands, D'Arros Island, off east side, depth 29–34 meters, Mar. 9, 1964, IIOE Sta. F–105, 80.3 mm. USNM 200762, Seychelles Islands, Amirante Islands, near St. Joseph Island, southwest of Ressource Island, off small boat entrance to lagoon, depth 15–27 meters, Mar. 10, 1964, IIOE Sta. F–110, 91 mm.

DESCRIPTION.—Counts are recorded in table 2, and measurements made on the holotype and paratypes are expressed in thousandths of the standard length in table 6.

Vomer with teeth, none on palatines; 6 canine teeth (3 on each side), near tip of lower jaw; spinous dorsal fin connected by membrane to first soft dorsal ray opposite tip of fifth dorsal spine; ninth or tenth branched pectoral ray from dorsal edge longest; upper caudal fin ray elongate and slightly projecting; scales around caudal peduncle in a zigzag row 26.

COLOR IN ALCOHOL.—Body light tan ventrally, light brown dorsally with 3 irregular rows of brown spots on upper sides becoming 2, then 1, on the peduncle; the brown background coloration of the upper side forms 7 light brown bars, separated by light straw coloration,

the bars not extending below the lower row of spots associated with the brown background bars; middle of side with broad light band, speckled with tiny brown spots irregularly spaced and not in a row; lower side of body behind pectoral base with 8 dark bars, the first is composed of 2 or 3 dark spots in a narrow dark streak that meets or almost meets its fellow about midway between anus and pelvic base; the next 7 bars are composed of large dark spots dorsally, thence becoming paler and narrower as they extend ventrally, but not reaching anal fin base; axis of pectoral base with a narrow black bar that extends ventrally and meets its fellow across belly just behind pelvic fin bases; all of the body bars are in line with black spots in the median fins; base of caudal fin with a pair of small dark spots; front of base of pectoral with 2 to 4 small black spots; lower edge of pectoral fin with a small black spot basally; 6 dark spots in a row across top of head behind orbits and a pair of dark spots of same size in front of the row of spots at rear of interorbital space; a few other dark spots in interorbital space; side of head with dark spots and 2 oblique dark bars from below eye extending posteroventrally; caudal fin with tiny dark spots, irregularly scattered; anal fin with 2 rows of dark spots, the basal row composed of larger spots; dorsal

TABLE 6.—*Measurements made on three new species of* Parapercis *expressed in thousandths of standard length*

Characters	*P. bivittata*				*P. somaliensis*			*P. trispilota*			
	Holotype USNM 200752	Paratypes USNM 200754	200753	200762	Holotype USNM 200751	Paratypes USNM 200750		Holotype USNM 200721	Paratypes USNM 200722	200725	200723
Standard length (in mm)	114	90	80.3	91	105	120	81	69	98	74.5	47
Length of head	273	300	290	288	312	308	316	283	281	304	298
Length of snout	97	92	101	92	97	103	91	116	85	99	81
Diameter of eye	61	72	64	66	82	83	94	77	66	74	87
Width fleshy interorbital space	40	42	40	38	51	48	33	35	40	40	32
Snout tip to rear edge of maxillary	111	121	105	115	133	132	123	103	107	113	114
Least depth of body	90	91	87	88	93	93	90	90	92	86	89
Greatest depth of body	171	178	162	185	200	196	210	175	179	174	168
Length of fourth dorsal spine	74	87	87	80	86	87	90	87	80	84	94
Longest pectoral fin ray	174	202	192	179	181	183	185	178	199	201	213
Longest pelvic fin ray	200	228	235	230	210	196	222	234	225	245	277
Longest caudal fin ray	175	211	204	209	257	238	200	184	177	188	213
Length of base of dorsal fin	615	644	632	631	633	621	605	634	651	625	617
Length of base of anal fin	420	444	452	444	449	439	420	435	434	423	448

fin with 3 lengthwise rows of dark spots, the distal row represented by tiny spots as in the anal fin, whereas the two rows, medially and basally, composed of larger dark spots.

DISCUSSION.—This new species traces through Cantwell's key (1964, p. 248) to section 17b and is related to a group of species centering around *P. xanthozona*, *P. kamoharai*, *P. somaliensis*, new species, and *P. trispilota*, new species, described below. *Parapercis kamoharai* has 30–32 scales in a zigzag row around caudal peduncle, 66–72 oblique scale rows, distinct dark cross bars on head, whereas, *P. bivittata* has 26 scales around the caudal peduncle, 58 or 59 oblique scale rows along upper side, and a color pattern completely unlike that of *P. kamoharai*. *Parapercis bivittata* differs from *P. xanthozona* in having only 5 scales above lateral line instead of 6–8; also *P. bivittata* has fewer gill rakers (see table 3) than *P. xanthozona* and a different color pattern.

Parapercis bivittata, new species, differs from *P. trispilota*, new species, chiefly in regard to color pattern, as follows:

Characters	*trispilota*	*bivittata*
number of dark bars across belly between pelvic fin bases and anus	none	2
number of dark spots in the area between depressed pectoral and pelvic fins	3	none
small black specks or spots in light broad band lengthwise along middle of sides	none	numerous
ventral basal edge of pectoral with a black spot	absent	present
axil of pectoral base with a black bar	absent	present
interior side of pectoral base with black spots	none	2–4
number of dark spots on cheek in addition to one below eye	none	4 or 5
dark spots along posterior edge of preopercle	1 or 2	3 or 4
dark spots on branchiostegal memberanes	1 large or 2 small ones	3–5 small ones

The name "*bivittata*" refers to the 2 black streaks across the belly.

***Parapercis trispilota*, new species**

PLATE 4

HOLOTYPE.—USNM 200721, Seychelles Islands, Curieuse Island, just southeast of point forming south end of Laraie Bay, depth about 9 meters, Feb. 23, 1964, IIOE Sta. F–64, standard length 69 mm.

PARATYPES.—USNM 200719, Seychelles Islands, Mahé Island off north tip north of North Island, depth about 27 meters, Feb. 15, 1964, IIOE Sta. F–52, 66 mm. USNM 200722, Seychelles Islands, Mahé, North Islet, west side, depth 8–18 meters, Mar. 16, 1964, IIOE Sta. F–115, 3 specimens, 63–98 mm. USNM 200723, Seychelles Islands, Amirante Islands, D'Arros Island, off east side, depth 24 meters, Mar. 8, 1964, IIOE Sta. F–103, 47 mm. USNM 200724,

Seychelles Islands, Amirantes Islands, D'Arros Island, off east side, depth 29–110 meters, Mar. 9, 1964, IIOE Sta. F–105, 80.3 mm. USNM 200725, Seychelles Islands, Amirantes Islands, near St. Joseph Island, southwest of Ressource Island, depth 27–31 meters, Mar. 7, 1964, IIOE Sta. F–95, 74.5 mm. USNM 200726, Seychelles Islands, near Praslin, south of Round Island, depth 12–15 meters, Feb. 22, 1964, IIOE Sta. F–61, 76.5 mm. USNM 200727, Seychelles Islands, Amirantes Islands, Eagle Islands off north end, depth 6–9 meters, Mar. 4, 1964, IIOE Sta. F–85, 49 mm.

DESCRIPTION.—Counts are recorded in table 2, and measurements made on the holotype and paratypes are expressed in thousandths of the standard length in table 6.

Vomer with teeth, none on palatines; 6 canine teeth (3 on each side) near tip of lower jaw; spinous dorsal fin connected by membrane to first soft dorsal ray nearly opposite tip fifth dorsal spine; ninth branched pectoral ray longest; none of the caudal fin rays elongated and projecting; scales in zigzag row around caudal peduncle 25.

COLOR IN ALCOHOL.—Body light tan, upper sides and back with 9 dusky cross bars, one in front of spiny dorsal, 7 along base of dorsal and one on caudal peduncle; 3 lengthwise rows of small dark spots across dark cross bars becoming 2, then 1, row on caudal peduncle; a broad light band along midside without spots; along middle of lower side 7 or 8 dark spots, each at the dorsal end of a light brown bar that fades ventrally and not reaching anal fin base; pair of small dark spots at base of caudal fin; caudal fin minutely spotted distally; 6 brown spots in a row across head behind eyes with a few dark spots or a pair of dark spots posteriorly in interorbital space. The most characteristic black spots are the 3 in a row beginning between bases of pectoral and pelvic fins and continuing evenly spaced to a vertical line through the middle of a light interspace between the first 2 dark bars at base of dorsal fin; spiny dorsal fin blackish; 2 rows of dark spots lengthwise along anal and 3 in soft dorsal, the distal row in each fin composed of very tiny dark spots.

DISCUSSION.—*Parapercis trispilota* differs from *P. xanthozona*, *P. kamoharai*, and *P. somaliensis* in the same ways that *P. bivittata* differs from them, except in color pattern. *Parapercis trispilota* and *P. bivittata* are distinguished adequately under "Discussion" in *P. bivittata*.

The name "*trispilota*" refers to the 3 dark spots on the area below the depressed pectoral fin.

Additional Species

In addition to the four new species, four other species of *Parapercis* were collected by the three expeditions: *P. hexophthalma* (Cuvier and

Valenciennes), *P. clathrata* Ogilby, *P. cepholopunctata* (Seale), *P. pulchella* (Temminck and Schlegel). In addition, the range for the following three species was extended.

***Parapercis nebulosa* (Quoy and Gaimard)**

The following two collections represent an extension of the range farther into the southern and farther into the northern parts of the Indian Ocean than previously reported: USNM 200718, Dec. 17, 1964, IIOE, Cruise 9, Sta. 462, off Somali Coast, 11°21′N 51°9′E, hand line, 1 spec., 177 mm. USNM 200720, Sept. 25, 1964, IIOE, Cruise 8, Sta. 394B, 29°27′S 31°31′E, shrimp trawl, 1 spec., 195 mm.

***Parapercis schauinslandi* (Steindachner)**

USNM 200763, Mar. 9, 1964, IIOE, Sta. F–105, Seychelles Islands, Amirante Islands, D'Arros Island off east side, depth 27–34 meters, 1 spec., 57 mm. USNM 200764, Mar. 10, 1964, IIOE, Sta. F–110, Seychelles Islands, Amirante Islands, near St. Joseph Island, southwest of Ressource Island, off small boat entrance to lagoon, depth 15–27 meters, 2 spec., 49–65 mm.

The three specimens listed above represent the first known occurrence of this species outside the Hawaiian Islands and the first record for the Seychelles Islands. Usually a reef-inhabiting species found such a great distance apart without occupying the intervening seas is likely to show at least subspecific differences when the populations are compared. In this case, the only possible difference observed was the probability of about one more gill raker on the first arch of the Seychelle specimens. With only three specimens, however, the variability cannot be determined and undoubtedly the range of counts would overlap when more specimens are studied. Tentatively, I refer these Seychelles specimens to *P. schauinslandi*.

***Parapercis polyophthalma* (Cuvier and Valenciennes)**

The following specimens represent the first record of this species from the Seychelles Islands: USNM 200698, Feb. 14, 1964, IIOE, Field No. JR–72, East Aurbariobi-Nossi Be, Madagascar, 13°26′10″S 48°22′54″E, 3 spec., 101–161 mm. USNM 200699, Mar. 10, 1964, IIOE, Sta. F–110, Amirantes Islands, St. Joseph Island, depth 15–27 meters, 4 spec., 113–126 mm. USNM 200700, Mar. 7, 1964, IIOE, Sta. F–95, Amirantes Islands, near St. Joseph Island, depth 25–30 meters 2 spec., 119–133 mm. USNM 200701, Feb. 10, 1964, IIOE, Sta. F–37, Mahé vicinity, Seychelles Islands, depth to 3 meters, 1 spec., 53 mm. USNM 200702, Feb. 4, 1964, IIOE, Sta. F–23, Near Mahé, Seychelles Islands, 1 spec., 59 mm. USNM 200703,

Feb. 2, 1964, IIOE, Sta. F–17, Mahé, Seychelles Islands, depth to 3 meters, 3 spec., 43–71 mm. USNM 200742, Jan. 27, 1964, IIOE, Sta. F–7, Beacon Island, Seychelles Islands, depth 11–15 meters, 1 spec., 30 mm. USNM 200743, Dec. 8, 1964, IIOE, Cruise 9, Sta. HA–19, Indian Ocean, Amirante Islands, St. Joseph Island, Ressource Island, 5°24′50″S 53°19′43″E, 2 spec., 107–112 mm. USNM 200744, Jan. 24, 1964, IIOE, Sta. F–4, Faon Island, Seychelles Islands, depth 13 meters, 1 spec., 61 mm. USNM 200745, Jan. 29, 1964, IIOE, Sta. F–11, Faon Island, Seychelles Islands, depth 11–12 meters, 4 spec., 48–58 mm. USNM 200746, Mar. 6, 1964, IIOE, Sta. F–90, Amirantes Islands, D'Arros Island, depth 6–9 meters, 1 spec., 117 mm. USNM 200747, Jan. 28, 1964, IIOE, Sta. F–10, Faon Island, Seychelles Islands, depth 12–15 meters, 6 spec., 46–119 mm.

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